

U.S. Patent Application Serial No. 10/560,037
Amendment filed November 6, 2008
Reply to OA dated August 7, 2008

AMENDMENT TO THE DRAWINGS:

Attached are a Replacement Drawing Sheet providing an amendment to Fig. 5, and an annotated Drawing Sheet detailing the amendment made.

U.S. Patent Application Serial No. 10/560,037
Amendment filed November 6, 2008
Reply to OA dated August 7, 2008

REMARKS

Claims 1-6 are pending in this application. Claim 1 is amended herein. Upon entry of this amendment, claims 1-6 will be pending. Fig. 5 is amended. Entry of this amendment and reconsideration of the rejections are respectfully requested.

No new matter has been introduced by this Amendment. Support for the amendments to the claims is discussed below.

The listing of references in the specification is not a proper information disclosure statement. (Office action paragraph no. 2)

An information disclosure statement is concurrently filed herewith, citing JP 2001-280252, disclosed on page 1 of the specification.

Figure 5 should be designated by a legend such as -- Prior Art -- because only that which is old is illustrated. (Office action paragraph no. 3)

The objection is overcome by the amendment to Fig. 5, labeling this drawing as "Prior Art."

The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed. (Office action paragraph no. 4)

U.S. Patent Application Serial No. 10/560,037
Amendment filed November 6, 2008
Reply to OA dated August 7, 2008

The objection to the title is respectfully traversed. The Examiner does not explain why the title is not considered descriptive, and Applicant submits that the title is consistent with the present claims.

The abstract of the disclosure is objected to because they [sic] include reference characters which are not enclosed within parentheses. (Office action paragraph no. 5)

The objection to the abstract is respectfully traversed. Applicant notes that there is a requirement (MPEP 608.01(m)) that when reference numerals appear in the **claims**, that they be in parentheses. However, Applicant is aware of no such requirement for the abstract.

Claim 1 is rejected under 35 U.S.C. §103(a) as being unpatentable over APA in view of Tojo et al. (Tojo) (Patent No. 4,816,245). (Office action paragraph no. 6)

Reconsideration of the invention is respectfully requested in view of the amendment to claim 1.

First of all, claim 1 has been amended to clarify the location of the suction space: "a suction space is formed in an outer periphery of said fixed scroll." Support for this amendment may be found in the specification at page 6, lines 9-13, where the suction space is referred to as "outer peripheral suction space 9."

U.S. Patent Application Serial No. 10/560,037
Amendment filed November 6, 2008
Reply to OA dated August 7, 2008

Secondly, claim 1 has been amended to recite "pressure in said inner region is set to discharge pressure Pd." Support for this amendment may be found at page 6, last line, to page 7, line 1, of the specification. This amendment clarifies the term "discharge pressure Pd."

Thirdly, claim 1 has been amended to recite that: "a pressure ratio (Pd/Ps) between the discharge pressure Pd and the suction pressure Ps is set to 2 to 6." Support for this amendment may be found at page 8, lines 16-20, of the specification.

In the rejection, the Examiner considers Fig. 5 and the description on page 1 of the specification to be admitted prior art. The Examiner states that the difference between Fig. 5 and claim 1 is that "APA fails to disclose a range of a ratio of a diameter of the orbiting mirror plate of the orbiting scroll and an outer diameter of the annular seal." The Examiner states that "Tojo teaches that it is conventional in the art to utilize a range of a ratio of a diameter of the orbiting mirror plate 15 of the orbiting scroll 4 and an outer diameter of the annular seal 22 being set greater than 0.5," citing Fig. 1 of Tojo. The Examiner also indicates that the claimed values for these parameters represent only "discovering the optimum or workable ranges" of these parameters.

However, Applicant submits that Tojo does not disclose or suggest the limitations of amended claim 1. This can be seen with reference to Fig. 3 of the present application.

Fig. 3 shows a case in which Pd is applied to the inner region 12a of the annular seal 11 in the back pressure chamber 12 of the orbiting scroll 5, and Ps is applied to the outer region 12b. More specifically, Fig. 3 shows a relation between the thrust and the diameter ratio d/D in the case that the operation condition is varied, and thrust is calculated from a pressure balance applied to the orbiting

mirror plate 5a of the orbiting scroll 5. As described (in lines 20 to 27 on page 8 of the specification), the thrust is calculated from a pressure balance applied to the orbiting mirror plate 5a of the orbiting scroll 5, and the relation between the thrust and the diameter ratio d/D was found.

This will be explained in detail using the reference drawing, shown below. If a pressing force pressing the orbiting scroll 5 toward the fixed scroll 4 becomes smaller than resultant of forces of pressures in the compressed chambers, the fixed scroll and the orbiting scroll 5 separate from each other. Thus, in the conventional scroll compressor, the back pressure chamber 12 is provided on a surface (back surface) of an orbiting scroll 5 opposite from the orbiting scroll wrap surface, the back pressure chamber 12 is divided into the inner region 12a and the outer region 12b by an annular seal 11, lubricant oil in the discharge pressure state is supplied to the inner region 12a of the annular seal 11, a portion of this lubricant oil is supplied to the outer region 12b through a narrowed portion 13, and the lubricant oil of the outer region 12b is supplied to a suction space 9 through the pressure adjusting mechanism 20. With this configuration, the outer region 12b is set to the intermediate pressure P_m between the suction pressure P_s and the discharge pressure P_d , thrust is applied to the back surface of the orbiting scroll 5, thereby allowing the orbiting scroll 5 to come into contact and slide with the fixed scroll 4.

That is, the pressure is applied to the entire area of the back surface of the orbiting scroll 5, thereby generating a force greater than the resultant of forces of the pressures in the compressed chambers, and the orbiting scroll 5 is pushed toward the fixed scroll 4.

Here, according to the conventional structure, lubricant oil is first supplied to the inner region 12a of the annular seal 11 and then, the lubricant oil is supplied to the outer space 12b, but the lubricant oil is not supplied to the suction space 9 formed by both the scroll parts 4 and 5 until the pressure in the outer space 12b becomes equal to the set intermediate pressure $P_m (=P_s+\Delta P)$, This is because that the lubricant oil in the outer space 12b is supplied to the suction space 9 through the pressure adjusting mechanism 20, and if the pressure in the outer space 12b reaches the set intermediate pressure $P_m (=P_s+\Delta P)$, the pressure adjusting mechanism 20 is operated and the lubricant oil in the outer space 12b is supplied to the suction space 9, but until the pressure in the outer space 12b reaches the set intermediate pressure $P_m (=P_s+\Delta P)$, the pressure adjusting mechanism 20 is not operated and the lubricant oil in the outer space 12b is not supplied to the suction space 9. As a result, there is a problem that when lubricant oil is not supplied to the fixed scroll 4 or orbiting scroll 5, both the parts are damaged or burned.

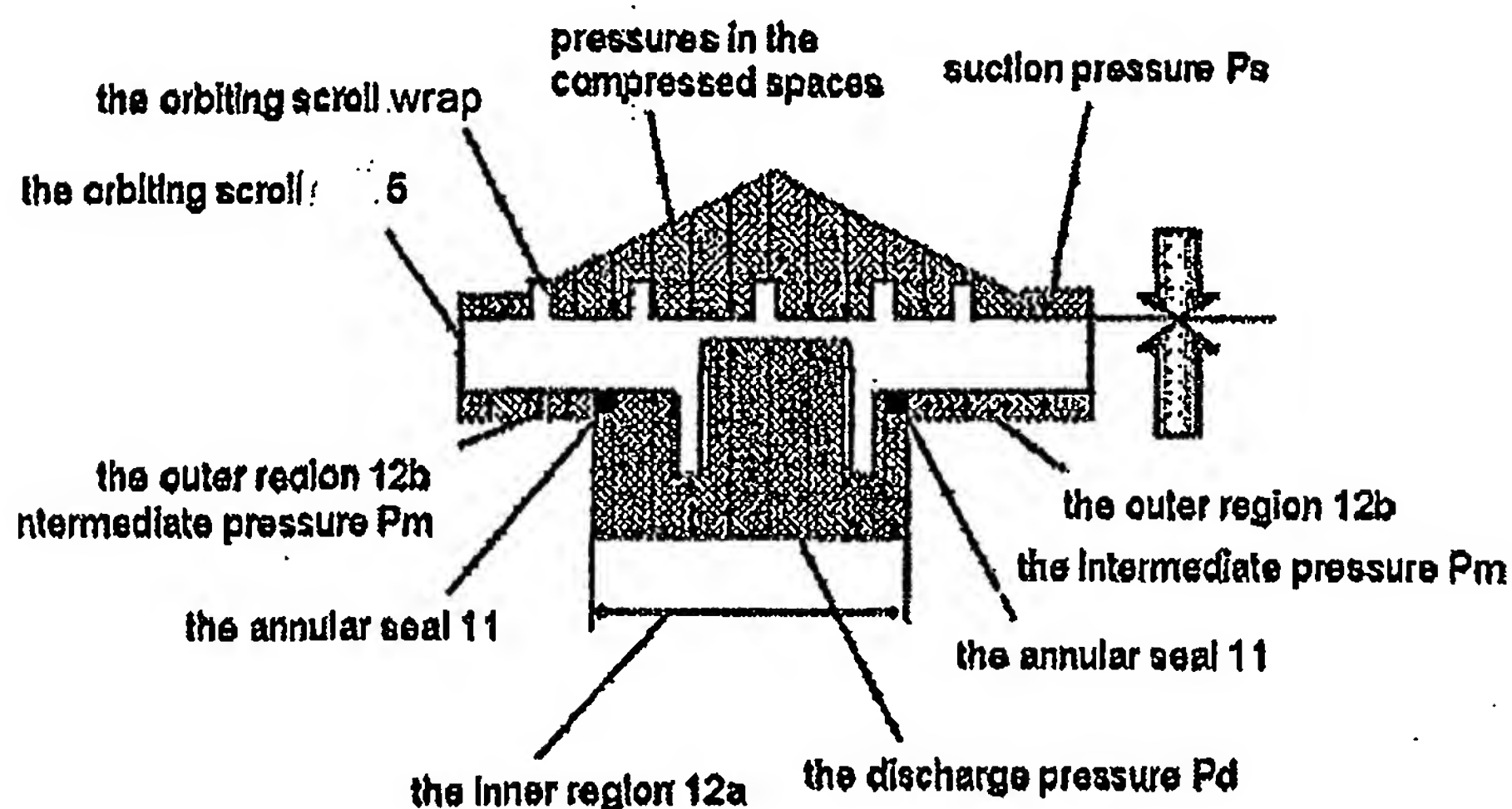
According to the present invention, the inner region 12a of the annular seal 11 which is a central portion of the back surface of the orbiting scroll 5 is mainly used, the orbiting scroll 5 is brought into contact and slide with the fixed scroll 4 only by the discharge pressure P_d applied to the inner region 12a of the annular seal 11 as means for obtaining the thrust greater than the resultant of forces of pressures in the compressed chambers, thrust is calculated from the pressure balance applied to the orbiting mirror plate 5a of the orbiting scroll 5, and the relation between the thrust and the diameter ratio d/D was found.

U.S. Patent Application Serial No. 10/560,037
Amendment filed November 6, 2008
Reply to OA dated August 7, 2008

The inventors found that if the diameter ratio (d/D) was set greater than 0.5, even if the discharge pressure is varied by the operation condition, positive (+) thrust can always be obtained, and the orbiting scroll 5 can be brought into contact and slide with the fixed scroll 4 only by the discharge pressure P_d applied to the inner region 12a of the annular seal 11. With this, the intermediate pressure P_m applied to the outer space 12b of the annular seal 11 can be set to the same value as the suction pressure P_s or a value close to the suction pressure P_s (here, the pressure adjusting mechanism 20 is set such that the scroll compressor is operated even when the back pressure AP is close to about zero) .

As a result, when the compressor is actuated, lubricant oil supplied to the outer space 12b of the annular seal 11 is supplied to the suction space substantially at the same time, supply delay of the lubricant oil is overcome, and even if refrigerant liquid is sucked by the suction space from the initial stage of actuation, the burning phenomenon on the sliding surface does not occur.

Reference drawing



In the present invention, the reason why the ratio (d/D) is set to a value greater than 0.5 is that even if the discharge pressure is varied by the operation condition, positive (+) thrust can always be obtained. For this, it is absolutely necessary that the inner region of the annular seal 11 has the discharge pressure Pd. That is, if the inner region of the annular seal 11 does not have the discharge pressure Pd, the technical problem can not be solved. A back pressure chamber of Tojo et al (USP 4, 861,245) has a pressure between a suction pressure and a discharge pressure (lines 47 to 53 in column 4) . That is, since the pressure in the back pressure chamber of Tojo et al is not the discharge pressure, the effect of the present invention can not be obtained.

It is described in Tojo et al that when a force caused by a pressure added to a back surface 15a of an orbiting scroll member 4 is smaller than thrust in an axial direction, a pedestal 20 functions as a thrust bearing (lines 54 to 64 in column 4 of Tojo et al.).

U.S. Patent Application Serial No. 10/560,037
Amendment filed November 6, 2008
Reply to OA dated August 7, 2008

Positive (+) thrust can always be obtained in the present invention, but Tojo et al. obviously allows negative thrust to be generated, and the function of the present invention is quite different from that of Tojo et al.

Claim 2 is rejected under 35 U.S.C. §103(a) as being unpatentable over APA in view of Tojo as applied to claim 1 above, and further in view of Ikeda et al. (Ikeda) (Publication No. CN 1420965). (Office action paragraph no. 7)

Reconsideration of the rejection is respectfully requested in view of the amendment to base claim 1.

The Examiner states that Ikeda teaches utilizing a back pressure applied to the outer region divided by the annular seal, set such that a ratio of the back pressure and a saturation pressure when the refrigerant gas is at 0 °C is substantially a constant value and 0.2 or lower.

Applicant has explained above how the limitations of amended claim 1 are not taught or suggested by Tojo et al., and submits that Ikeda et al. also does not disclose or suggest these limitations.

Claims 3 and 5 are rejected under 35 U.S.C. §103(a) as being unpatentable over APA in view of Tojo as applied to claim 1 above, and further in view of legal precedent. (Office action paragraph no. 8)

U.S. Patent Application Serial No. **10/560,037**
Amendment filed November 6, 2008
Reply to OA dated August 7, 2008

Reconsideration of the rejection is respectfully requested in view of the amendment to base claim 1.

The Examiner states that it would have been obvious to use refrigerant having a dryness parameter of 0.5 or less, because this represents discovering the optimum of a workable range.

However, Applicant has argued above that the limitations of base claim 1 are not disclosed or suggested by Tojo et al.

Claims 4 and 6 are rejected under 35 U.S.C. §103(a) as being unpatentable over APA in view of Tojo as applied to claim 1 above, and further in view of Takasaki et al. (Takasaki) (Publication No. JP 2000-136782). (Office action paragraph no. 9)

Reconsideration of the rejection is respectfully requested in view of the amendment to base claim 1.

The Examiner cites Takasaki as teaching that it is conventional in the art to use carbon dioxide as a refrigerant.

However, Applicant has argued above that the limitations of base claim 1 are not disclosed or suggested by Tojo et al., and Takasaki et al. also does not disclose or suggest these limitations.


U.S. Patent Application Serial No. **10/560,037**
Amendment filed November 6, 2008
Reply to OA dated August 7, 2008

If, for any reason, it is felt that this application is not now in condition for allowance, the Examiner is requested to contact the applicants' undersigned agent at the telephone number indicated below to arrange for an interview to expedite the disposition of this case.

In the event that this paper is not timely filed, the applicants respectfully petition for an appropriate extension of time. Please charge any fees for such an extension of time and any other fees which may be due with respect to this paper, to Deposit Account No. 01-2340.

Respectfully submitted,

KRATZ, QUINTOS & HANSON, LLP


Daniel A. Geselowitz, Ph.D.
Agent for Applicants
Reg. No. 42,573

DAG/xl

Atty. Docket No. **050806**
Suite 400
1420 K Street, N.W.
Washington, D.C. 20005
(202) 659-2930



23850

PATENT & TRADEMARK OFFICE

Enclosures: Replacement Sheet of Drawing (Fig. 5)
Annotated Sheet of Drawing (Fig. 5)
Information Disclosure Statement

H:\050\050806\Amendment in re OA of 08-07-08

Fig. 5 (Prior Art)

